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"...identifying, designating, managing and restoring the best remaining examples of natural communities and geological sites encompassing the full spectrum of Missouri's natural heritage"

Editor's Note

Missouri's Insect Diversity

Several years ago, in the spring following a December prescribed fire event in my urban woods, we discovered a motley assortment of highly charismatic leafhoppers that we wanted to identify. Rather than visiting random internet sites of questionable scholarship and accuracy, I asked esteemed entomologist and tiger beetle expert Ted MacRae for a field guide for insects appropriate for Missouri, but not overwhelming to someone without academic training in entomology. I wanted to know about the leafhoppers in my yard, about all the different sweat bees that visit my bright yellow cup plant flowers in August, and the cicadas and katydids whose choruses I hear around my bungalow in summer months. I recall Ted's response, always professional and friendly, and it was voluminous. According to *The Terrestrial Natural Communities of Missouri* (Nelson, 2010), in 2000, 87,107 native species and subspecies of insects existed in Missouri. Asking an expert in this highly special-

Pink-striped oakworm moths in the Elk River Breaks Woodland Natural Area. The caterpillars of this moth feed on oaks *(Quercus spp.)*, the dominant canopy tree in the natural area at Big Sugar Creek State Park. While some consider this species a forest pest, it has been well-documented that oak-specific caterpillars provide an important food source for breeding songbirds.

Photo by Allison J. Vaughn

Photo by Douglas Miller

Even in an urban setting, charismatic insects such as this candy-striped leafhopper *(Graphocephala coccinea)* can persist in a dense thicket of cup plant (*Silphium perfoliatum)*.

ized field for a basic pictorial guide to insects was probably a bit naïve on my part. But Ted delivered with a reference to Eric R. Eaton and Kenn Kaufman's *Field Guide to Insects of North America*, a wonderful and user-friendly identification book for the general user such as myself. I am not an entomologist by any stretch, but I have an interest in our state's rich insect diversity, and the role of a biodiverse insect population in all of the systematic ecological functioning of our native landscapes. Missouri is fortunately home to a range of experts in ants, bees, tiger beetles, dragonflies and damselflies, katydids and the myriad of other insects that inhabit our natural landscapes. For the 2015 issue of the Missouri Natural Areas Newsletter, we have invited several leaders in the field of entomology to discuss their areas of interest and research, and to share their thoughts on specialized biota and insect diversity in Missouri. This is a large topic to cover, and I recognize that we have only scratched the proverbial surface of knowledge in Missouri.

Much has been written in recent months about the importance of pollinators on the landscape, fueling an interest in creating pollinator habitats through gardening. The mission of the Missouri Natural Areas Program involves the recognition and preservation of our state's best remaining examples of natural communities with all facets of biodiversity represented. While pollinator gardens have been proven to provide nectar and nesting sites for suites of pollinating insects, it would be remiss to disregard the role of Missouri's intact native landscapes, especially our designated natural areas, in the protection and sustainability of insect diversity. The historic natural setting throughout much of the state, a landscape that existed before the age of extraction began, included thousands of acres of a grass-forb matrix that hosted not just monarch butterflies but an entire suite of insects and other biota that have been largely extirpated, barring populations that persist in remnants of high quality landscapes today. The restoration of

natural landscapes with a heterogeneous mix of native flora should be tantamount in conservation planning for pollinating insects, but restoration methods must be carefully implemented. Our highly fragmented, disturbed, and out-of-context landscapes may harbor some of the last remaining populations of rare species, both plant and animal.

With the 2005 publication of Paul Nelson's *The Terrestrial Natural Communities of Missouri*, the Missouri Natural Areas Committee endorsed the use of carefully applied prescribed fire for the restoration and maintenance of Missouri's fire-mediated systems. Since that time, fire management has been used on a larger, landscape-sized scale, inviting a series of questions and concern regarding the sustainability of relictual populations of insects and other biota. Without fire, the landscape will no longer provide the necessary facets for the sustainability of a given species, but with improperly applied fire, the very disturbance that certain insects depend on may be the cause of their demise or, worse, extirpation. Emulating natural disturbance processes on a landscape scale will naturally allow for refugia, if the process is properly implemented. This issue of the Missouri Natural Areas Newsletter highlights research on native bees, rare orchid pollinators, and other insects that serve as lynchpins for functioning ecosystem health. Contact the authors of the respective articles for more information and to continue the dialogue.

— Allison J. Vaughn, editor

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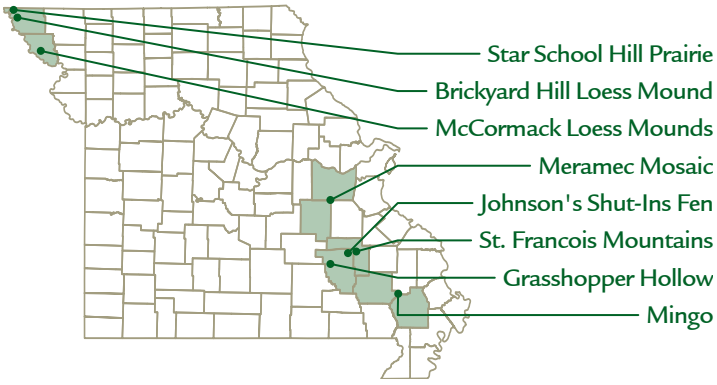
NATURAL AREAS FEATURED IN THIS ISSUE



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The Missouri Natural Areas Newsletter is an annual journal published by the Missouri Natural Areas Committee, whose mission is identifying, designating, managing and restoring the best remaining examples of natural communities and geological sites encompassing the full spectrum of Missouri's natural heritage. The Missouri Natural Areas Committee consists of the Missouri Department of Natural Resources, the Missouri Department of Conservation, the U.S. Forest Service, the U.S. Fish and Wildlife Service, the National Park Service and the Nature Conservancy.

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Missouri Department of Natural Resources

Photo by Christopher R. Brown

Saline Springs Tiger Beetle (*Habroscelimorpha circumpicta johnsonii*)

The Role of Missouri's Natural Areas and Other Conservation Lands in Preserving Tiger Beetle Diversity

By Ted C. MacRae

When Missourians think about wildlife diversity, usually the state's 800+ species of fish, amphibians, reptiles, birds, and mammals come to mind. In reality, the diversity title belongs to the perhaps 25,000 species of insects that share habitats with vertebrates, ranging from the microscopic (springtails) to the annoying (mosquitoes) to the revered (monarch butterfly). Among the most charismatic insects in Missouri are the tiger beetles, predaceous insects that favor open ground in a variety of lowland and upland habitats. Like their big cat namesakes, tiger beetles have huge eyes that can detect the slightest movement, long thin legs for running down prey, and large, toothy jaws for grabbing and promptly dispatching their hapless victims. While representing only a tiny fraction of the total insect fauna in Missouri, the 24 species of tiger beetle that live in the state still represent a level of diversity worthy of study and protection.

Tiger beetles frequently live in disturbed habitats with sparse vegetation, such as sandbars and erosion cuts, as well as along muddy banks, on glades and in forest litter. European settlement resulted in drastic alterations in the abundance and distribution of these habitats, and tiger beetle populations have been affected as a result. Dredging and straightening of streams and rivers, fire

Photos by Ted C. MacRae

Six-spotted Tiger Beetle (*Cicindela sexguttata*)

Bronze Tiger Beetle (*Cicindela repanda*)

Swift Tiger Beetle (*Cylindera celeripes*)

Punctured Tiger Beetle (*Cicindela punctulata*)

suppression, and grazing have all impacted species that live in the habitats these activities have affected. Some anthropogenic changes have actually benefited certain species—e.g., road, borrow sand pit and pond construction that create habitat for species favoring exposed clay and sand or water's edge. Common species in Missouri include *Cicindela sexguttata* (Six-spotted Tiger Beetle) on woodland trails, *Cicindela repanda* (Bronze Tiger Beetle) along the state's water courses, and *Cicindela punctulata* (Punctured Tiger Beetle) in a variety of open, upland habitats. Most species, however, have more specific requirements, and while the status of many species is secure, a few are rare or highly localized and, thus, warrant protection.

Among the rarest is *Cylindera celeripes* (Swift Tiger Beetle). These tiny, flightless beetles are restricted to the eastern/central Great Plains, where they mimic small ants or spiders as they dart amongst openings between clumps of grass in search of prey. The species lives almost exclusively in upland prairies and grasslands with clay/loess soils and sparse vegetation, and populations have declined dramatically over the past century due to conversion and other alterations of preferred habitat. The beetle was not even known in Missouri until 2009 when Christopher Brown and I discovered it in loess hilltop prairie remnants at Brickyard Hill, Star School Hill Prairie, and McCormack Loess Mounds Natural Areas—the largest and highest quality examples of this critically imperiled natural community remaining in Missouri. We have searched unsuccessfully for the beetle in other loess hilltop prairie remnants in the area, none of which have the size and quality that the above mentioned sites possess. This suggests that the beetle is sensitive to habitat alteration/reduction and emphasizes the need to design and implement land management practices at sites known to support populations to reduce the chance of localized extinction. Such measures include the use of disturbance factors that favor grasslands over forests, including removal of encroaching woody vegetation, judicious use of

prescribed burning, and/or selective grazing. It is essential that these measures be implemented in a manner that minimizes impacts to beetle populations—e.g., prescribed burning should be done on a rotational basis and when adults and larvae are not active (late fall through early spring), perhaps also establishing permanently unburned refugia where alternative disturbance factors are used to maintain open ground and limit encroachment. In addition, potentially suitable areas adjacent to known sites should be renovated to expand potential habitat and minimize isolation distances.

An even rarer species is *Dromochorus pruinina* (Loamy-ground Tiger Beetle), a grassland specialist normally found in Kansas, Oklahoma, and Texas. Known historically from a small series of museum specimens collected in Johnson Co., an extant population was located in 2005 in Knob Noster State Park. Intensive surveys of suitable habitat throughout west-central Missouri concluded that the beetle is restricted to exposed red clay embankments along a 2.5-mile stretch of just a single road in the park. Apparently suitable eroded clay roadsides exist elsewhere in the park and surrounding areas; however, they are disjunct and separated by woodlands that the flightless beetles cannot traverse or have been recently altered by road construction, The nearest known population lies 75 miles further west (in Olathe, Kansas), preventing genetic exchange with the main population and increasing the likelihood of loss of genetic diversity in Missouri's small, isolated population. Because of this, it is critical that efforts be made to increase the size of the population through creation of additional habitat to ensure viability of the population. Much of the park and surrounding environs are heavily forested and, thus, do not provide suitable habitat for the beetle. Prescribed burning has been implemented within portions of the park in recent years to restore the grasslands and open woodlands thought to be prevalent prior to European settlement. However, the beetle has not been found in these restored grasslands, most likely due to the high vegetational density and closed structure they exhibit rather than the patchwork of barren slopes that the beetle prefers. Thus, land management practices should be modified to create and maintain more

Loamy-ground Tiger Beetle (*Dromochorus pruinina*)

Photo by Ted C. MacRae

open clay exposures within restored grasslands adjacent to the roadside embankments where the beetle occurs and also convert additional adjacent forests/woodlands to more open grasslands.

Our most beautiful tiger beetle may have already been lost. *Habroscelimorpha circumpicta johnsonii* (Saline Springs Tiger Beetle) lives on barren soil near saline seeps in the central and south-central Great Plains. In Missouri, a highly disjunct population of the beetle occurred historically in central Missouri's saline seep habitats—a critically imperiled natural community that has been degraded significantly during the past century by altered hydrology, cattle trampling, invasive exotics, and other disturbances. While the beetles were abundant in past years, particularly at Boone's Lick State Historic Site, populations have declined dramatically more recently as the sites suffered vegetational encroachment. Prompted by this apparent decline, we conducted a survey of known and potential saline seep habitats in central Missouri during 2001–2003, finding only a single beetle at Boone's Lick and a small population (less than two dozen individuals) at Blue Lick Conservation Area. Three apparently suitable saline seeps exist at the latter site, but adults and larvae were only observed at one of them, and prolonged flooding of this particular seep during the third year of the study and subsequent years induced complete vegetational encroachment of the site. No beetles have been observed at Boone's Lick or Blue Lick in the years following the survey, and the likelihood of finding additional seeps capable of supporting the beetle seems very low. We conclude that Missouri's distinctive population of this beetle has declined below detectable limits and may have already been extirpated. The loss of this beetle from Missouri's fauna would represent a significant blow to our state's natural heritage, and it is imperative that any remaining saline seeps in central Missouri be protected and renovated if the beetle is to have any chance of surviving in the state. We have urged the Missouri Department of Conservation, the Missouri Department of Natural Resources, and other conservation organizations within the state to identify and allocate the resources needed to develop and implement a recovery plan for the species in Missouri.

Ted C. MacRae is a senior research entomologist and science fellow at Monsanto Company working on alternatives to insecticides for control of soybean pests. He is also an ardent natural historian and beetle taxonomist and has conducted numerous studies documenting the diversity and conservation status of Missouri's beetle fauna.

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Photo by Richard Day/Daybreak Imagery

A male Hine's Emerald Dragonfly (***Somatochlora hineana***) displaying identifying paint marks on wings.

Contributions of Designated Natural Areas to Recovery Efforts of Hine's Emerald Dragonfly in Missouri

By Dr. Paul M. McKenzie

Hine's Emerald Dragonfly (*Somatochlora hineana*) (HED) is a rare dragonfly in the United States and Ontario, Canada. The species was federally listed as an endangered species under the Endangered Species Act (ESA) of 1973 on January 26, 1995 (U.S. Fish and Wildlife Service 1995). In Ontario, it is protected under the Ontario Endangered Species Act of 2007 and the Accord for the Protection of Species at Risk in Canada (Pulfer et al. 2013). The species is considered one the most endangered dragonflies in the United States (Bick 1983, Cashatt 1991). Given the currently known restricted range in Ontario, the species is also undoubtedly critically imperiled there as well. The species was given protection under the ESA because of its narrow ecological requirements (especially of the larvae), its restricted geographic range, and the vulnerability of its habitat to degradation and destruction (Pulfer et al. 2013; U.S. Fish and Wildlife Service 1995, 2001).

Extant populations of *S. hineana* are known from Illinois, Michigan, Missouri, and Wisconsin in the United States (Cashatt and Vogt 2001, U.S. Fish and Wildlife Service 2001, Landwer and Vogt 2002, Vogt 2005) and from a single site in Ontario (Pulfer 2013). Historically, this species was reported from Alabama, Indiana, and Ohio but is now considered extirpated from those states (Vogt and Cashatt 1994, Cashatt and Vogt 2001, U.S. Fish and Wildlife Service 2001, 2013).

Hine's Emerald Dragonfly is restricted to high quality fens and calcareous wetlands characterized by shallow bedrock and seepage flow of ground water that support a diversity of graminoid vegetation and forbs. An abundance of crayfish burrows are necessary to provide habitat for larval development (U.S. Fish and Wildlife Service 1995, 2001; Vogt and Cashatt 1994).The initial discovery of this species in Missouri was made by Linden Trial in 1999 at Grasshopper Hollow Natural Area, Reynolds County (U.S. Fish and

Wildlife Service 2001, 2013). Extensive searches for this species were conducted between 2001 and 2014 in Missouri and consisted of a combination of adult and larval surveys (Day 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014; Landwer 2003; Landwer and Vogt 2002; U.S. Fish and Wildlife Service 2013; Vogt 2001, 2003, 2004, 2006; Walker and Smentowski 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014). Currently HED is extant at 20 sites scattered in Dent, Iron, Phelps, Reynolds, and Ripley counties (Walker and Smentowski 2014) and all are within the Ozark Highlands Ecological Section of Missouri (Nigh and Schroeder 2002; Nelson 2005). The natural community structure of all HED sites in Missouri are Ozark fens with the exception of one that includes a spring fed marsh and adjacent calcareous sedge meadow. Missouri HED sites vary in size from less than 1 acre to approximately 80 acres and are generally smaller than fen habitats in Illinois, Michigan, and Wisconsin. Hine's Emerald Dragonfly has two primary areas of distribution in Missouri's Ozarks: 1) sixteen sites that include Dent, Iron, Phelps and Reynolds counties and 2) four sites in Ripley County.

Of the 20 sites in Missouri where HED has been confirmed, three sites are designated natural areas: Grasshopper Hollow NA, Johnson Shut-Ins Fen NA, and Overcup Fen NA. Due to their smaller size, some odonatologists predicted that population levels at Missouri fens would be less genetically diverse and support smaller populations. Between 2001 and 2010, samples of HED were taken from sites throughout the state and compared genetically to material collected in other states. In 2013, we initiated mark and recapture studies using non-toxic paint following Mierzwa (1995) at Kay Branch Fen in Reynolds Co. to investigate densities in Missouri sites. Preliminary mark and recapture results indicate that HED populations at Missouri sites are robust and at higher densities than initially predicted despite their smaller size. In 2013, 331 HED were marked and released at Kay Branch Fen. Based on the number of single observations of marked individuals, a preliminary analysis suggests an estimate of over 1,000 individuals (Walker and Smentowski 2013, 2014).

In 2014, we conducted the second mark and recapture study at Onoclea Fen at Johnson Shut-Ins State Park. This fen is adjacent to Johnson's Shut-Ins Fen NA that was impacted by the reservoir breach of the Ameren UE dam; this fen likely shared the same HED individuals as the Onoclea Fen located across the road. The effort at Onoclea Fen resulted in the marking and release of 111

Grasshopper Hollow Natural Area in Reynolds County.

Photo by Allison J. Vaughn

Jane Walker and Joe Smentowski at marking station in Onoclea Fen, Johnson Shut-ins State Park.

Male HED being processed with wing paint.

Photos by Richard Day/Daybreak Imagery

individuals and 154 subsequent single observations or recaptures of marked HED. The preliminary estimate at this site is 206 individuals (Day 2014; Walker and Smentowski 2014), and although smaller than the population at Kay Branch Fen, the results suggest that HED populations in Missouri are several magnitudes higher than previously postulated.

Genetic analyses of HED material from Missouri and elsewhere conducted by Dr. Meredith Mahoney of the Illinois State Museum has yielded some exciting trends regarding the genetic diversity across the range of the species as well as insights into movements and/or dispersal of this dragonfly in Missouri. Dr. Mahoney has documented that Missouri has the highest genetic diversity of any state within the range of the species (pers. comm. June 2015: unpublished data). To date, she has documented 10 unique haplotypes scattered across the species' five-county range in Missouri. Of these, Grasshopper Hollow NA in Reynolds Co. and Barton Fen in Iron Co. share two haplotypes found nowhere else within the range of HED. These sites are approximately 15 air miles from one another and her data documents genetic connectivity between these sites sometime in the recent past (Meredith Mahoney, pers. comm. June 2015: unpublished data). Although we have not conducted a similar population estimate survey at Grasshopper Hollow NA, it is projected that the number will be high given its size and native integrity related to other HED fens in Missouri.

Mahoney has also determined that the Ripley Co. HED sites support a unique genetic haplotype which is shared among localities in this county. As with Grasshopper Hollow NA and Barton Fen, the sharing of genetic haplotypes in Ripley Co. provides additional insight into dispersal and movement patterns of HED in the state (Meredith Mahoney, pers. comm. June 2015; unpublished data).

Additional mark/recapture studies of HED are planned at other sites in Missouri, including Grasshopper Hollow NA. The continued assessment of population estimates, dispersal patterns, and movement of HED in Missouri will help direct management recommendations in the future to ensure the persistence of this species in the state. Initial population estimates and genetic results suggest that Missouri's designated natural areas will continue to contribute towards the recovery of HED in Missouri.

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References:

Cashatt, Everett D., and Timothy E. Vogt. 1996. Population and habitat monitoring of Hine's Emerald Dragonfly (*Somatochlora hineana* Williamson) in northeastern Illinois in 1995. Unpublished report to the U.S. Fish and Wildlife Service. 77 pp.

Day, R. 2007. Hine's Emerald Dragonfly (*Somatochlora hineana*) in Missouri – 2007. Unpublished report to the Missouri Department of Conservation. 39pp.

Day, R. 2008. Hine's Emerald Dragonfly (*Somatochlora hineana*) in Missouri – 2008. Unpublished report to the Missouri Department of Conservation. 47pp.

Day, R. 2009. Hine's Emerald Dragonfly (*Somatochlora hineana*) in Missouri – 2009. Unpublished report to the Missouri Department of Conservation. 49pp.

Photo by Richard Day/Daybreak Imagery

HED field crew at Onoclea Fen, Johnson Shut-Ins State Park.

Day, R. 2010. Hine's Emerald *Somatochlora hineana* & Ozark Emerald *Somatochlora ozarkensis* surveys in Missouri 2010. Unpublished report to the Missouri Department of Conservation. 51pp.

Day, R. 2011. Hine's Emerald *Somatochlora hineana* & Ozark Emerald *Somatochlora ozarkensis* surveys in Missouri 2011. Unpublished report to the Missouri Department of Conservation. 33pp.

Day, R. 2012. Hine's Emerald *Somatochlora hineana* & Ozark Emerald *Somatochlora ozarkensis* surveys in Missouri 2012. Unpublished report to the Missouri Department of Conservation. 27pp.

Day, R. 2013. Hine's Emerald *Somatochlora hineana* & Ozark Emerald *Somatochlora ozakensis* surveys in Missouri 2013. Unpublished report to the Missouri Department of Conservation. 26pp.

Day, R. 2014. Hine's Emerald *Somatochlora hineana* & Ozark Emerald *Somatochlora ozakensis* surveys in Missouri 2014. Unpublished report to the Missouri Department of Conservation. 23pp.

Landwer, Brett H. P. 2003. Observations of the Hine's Emerald Dragonfly (*Somatochlora hineana*) in Missouri, 2002. Unpublished report to the Missouri Department of Conservation. 63 pp. + appendix.

Landwer, Brett H. P., and Timothy E. Vogt. 2002. Survey for Hine's Emerald Dragonfly (*Somatochlora hineana*) larval habitat in the Missouri Ozarks — 2002. Unpublished report to the Missouri Department of Conservation. 17 pp. + appendix.

Mierzwa, Kenneth S., A. P. Smyth, C. Ross, E. D. Cashatt, T. E. Vogt, and A.V. Gochee. 1995. A population and habitat study of Hine's Emerald Dragonfly, *Somatochlora hineana* at the Material Service Corporation Yard 61 Middle Parcel and nearby sites in Will County, Illinois. Unpublished report, TAMS Consultants, Inc. Chicago. 43pp.

Nelson, P.W. 2005. *The Terrestrial Natural Communities of Missouri*. The Missouri Natural Areas Committee. Jefferson City, 550pp.

Nigh, T.A. and W.A. Schroeder, 2002. Atlas of Missouri ecoregions. Missouri Department of Conservation, Jefferson City, Missouri.

Pulfer, T.L., C.G. Evans, D. Featherstone, R. Post, J.I. McCarter, and J.F. Laverty. 2013. Recovery strategy for the Hine's Emerald (*Somatochlora hineana*) in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vi. +27pp.

U. S. Fish & Wildlife Service. 2001. Hine's Emerald Dragonfly (*Somatochlora hineana*) recovery plan. Fort Snelling, Minnesota. 120 pp.

U. S. Fish & Wildlife Service. 2013. Hine's Emerald Dragonfly, *Somatochlora hineana*, (Odonata: Coduliidae) — 5-year review: summary and evaluation. Barrington, Illinois. 50pp.

Vogt, Tim E. and E. D. Cashatt. 1994. Distribution, habitat, and field biology of *Somatochlora hineana* (Odonata: Cordullidae). *Annals of the Entomological Society of America* **87**:599-603.

Vogt, Timothy E. 2001. The 2001 status survey for the Hine's Emerald Dragonfly (*Somatochlora hineana*) in the Missouri Ozarks. Unpublished report to the U. S. Fish and Wildlife Service, U. S. Forest Service, and Missouri Department of Conservation. 26 pp. + appendix.

Vogt, Timothy E. 2003. A status survey for the Hine's Emerald Dragonfly (*Somatochlora hineana*) in Missouri — 2002. Unpublished report to the U. S. Fish and Wildlife Service and Missouri Department of Conservation. 45 pp. + appendix.

Vogt, Timothy E. 2004. A status survey for the Hine's Emerald Dragonfly (*Somatochlora hineana*) in Missouri — 2003. Unpublished report to the Missouri Department of Conservation. 33 pp. + appendix.

Vogt, Timothy E. 2006. Population monitoring and status survey for the Hine's Emerald Dragonfly (*Somatochlora hineana*) in Missouri — 2005. Unpublished report to the Missouri Department of Conservation. 28pp.

Vogt, Timothy E. 2011. The 2010 Fall/Winter larval survey for Hine's Emerald Dragonfly (*Somatochlora hineana*) in the Missouri Ozarks. Unpublished report to the Missouri Department of Conservation. 54 pp.

Walker, Jane C., and Joseph H. Smentowski. 2002. Search for the Hine's Emerald Dragonfly (*Somatochlora hineana*) in Missouri — 2002. Unpublished report to the Missouri Department of Conservation. 20 pp. + appendices.

Walker, Jane C., and Joseph H. Smentowski. 2003. Searches for new sites with the Hine's Emerald Dragonfly (*Somatochlora hineana* Williamson) in Missouri — 2003. Unpublished report to the Missouri Department of Conservation. 25 pp. + appendix.

Walker, Jane C., and Joseph H. Smentowski. 2004. Searches for Hine's Emerald Dragonfly (*Somatochlora hineana*) in Missouri — 2004. Unpublished report to the Missouri Department of Conservation. 17 pp. + appendix.

Walker, Jane C., and Joseph H. Smentowski. 2005. Searches for Hine's Emerald Dragonfly (*Somatochlora hineana*) in Missouri – 2005. Unpublished report to the Missouri Department of Conservation. 22 pp. + appendices.

Walker, Jane C. and Joseph H. Smentowski 2006. Hine's Emerald Dragonfly (*Somatochlora hineana*): population monitoring, status surveys, and DNA collections in Missouri — 2006. Unpublished report to the Missouri Department of Conservation. 29 pp. + appendix.

Walker, Jane C. and Joseph H. Smentowski 2007. Hine's Emerald Dragonfly (*Somatochlora hineana*): population monitoring, status surveys, and DNA collections in Missouri — 2007. Unpublished report to the Missouri Department of Conservation. 19 pp. + appendices.

Walker, Jane C. and Joseph H. Smentowski 2008. Hine's Emerald Dragonfly (*Somatochlora hineana* Williamson) surveys, DNA collections, and monitoring in Missouri in Missouri — 2008. Unpublished report to the Missouri Department of Conservation. 6pp.

Walker, Jane C. and Joseph H. Smentowski 2009. Hine's Emerald Dragonfly (*Somatochlora hineana* Williamson) surveys, DNA collections, and monitoring in Missouri in Missouri — 2009. Unpublished report to the Missouri Department of Conservation. 13 pp. + appendices.

Walker, Jane C. and Joseph H. Smentowski 2013. Mark-recapture population study of the Hine's Emerald Dragonfly (*Somatochlora hineana* Williamson) — Kay Branch Fens, Reynolds County, Missouri. Unpublished report to the Missouri Department of Conservation. 27 pp. + appendices.

Walker, Jane C. and Joseph H. Smentowski 2014. Mark-recapture population study of the Hine's Emerald Dragonfly (*Somatochlora hineana*) at Johnson Shut-ins State Park, Missouri. Unpublished report to the Missouri Department of Conservation. 17 pp. + appendices.

Searching for Potential Prairie Orchid Pollinators

by Dr. David Ashley

Many people have the impression that orchids are only found in dense tropical rainforests. They are often surprised to find out that more than a dozen species of orchids are often found in Missouri. They are even more surprised to learn that several orchid species are associated with prairie habitats. Since the mid-1990s, I have been collaborating with volunteers and staff of state and federal agencies to study the populations of two species of prairie orchids. Participants in the surveys include students from Missouri Western State University, volunteers from the Missouri Master Naturalists and the Missouri Native Plant Society, Missouri Department of Conservation staff (Tom Nagel, Steve Buback, Noppadol Paothong) and U.S. Fish and Wildlife Service staff (Dr. Paul McKenzie and Trisha Crabill). The western prairie fringed orchid (*Platanthera praeclara*) is found in a limited number of prairies in northwest Missouri. We have been monitoring these populations since 1996. The eastern prairie fringed orchid (*Platanthera leucophaea*) was assumed extirpated from the state until a population was discovered by Tom Nagel in north central Missouri in 2009. The collaborative survey team continues to monitor both species annually.

Occurrence records for both orchid species indicate they were once more broadly distributed in Missouri than they are today; both species are currently feder-

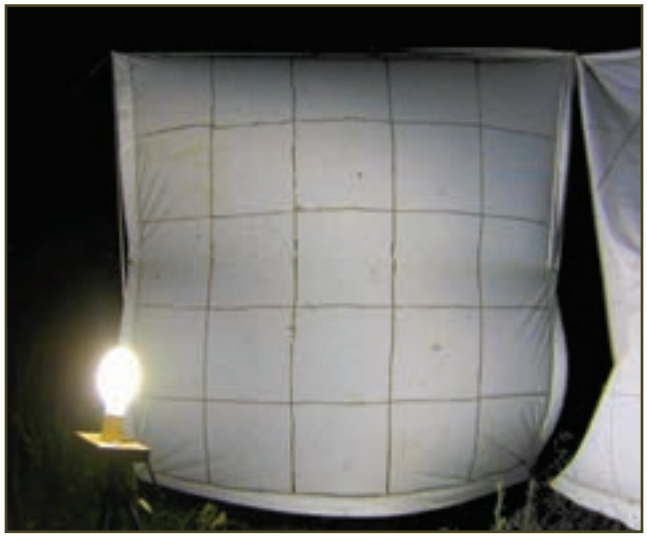
Photo by Steve Buback, Missouri Department of Conservation

Peak flowering of an Eastern prairie fringed orchid (*Platanthera leucophaea* (Nutt.) Lindl.) during mid-June in north Missouri.

Photo by David Ashley

BioQuip blacklight bucket trap positioned on northwest Missouri prairie.

Photo by David Ashley



Mercury vapor lamp shining on suspended white bedsheets during a prairie visit.

Photo by Steve Buback, Missouri Department of Conservation

Positioned at flowering orchids in anticipation of arrival of night-flying hawkmoths.

ally threatened and state endangered. Appropriate management is critical to maintaining the remaining populations. Information on natural history is always important in determining management protocols for species of conservation concern. The determination of a plant's native pollinator remains an important aspect for the viability of the species. Knowing the native pollinator allows for conservation of the plant as well as the insect responsible for helping the species produce seed and reproduce.

We are currently searching for the most important pollinators for the prairie orchids. Earlier research determined that hawkmoths (Lepidoptera: Sphingidae) are often associated with pollination of the *Platanthera* species. Hawkmoths are fast-flying moths as adults and as caterpillars (commonly called horn-worms), they are fairly specific to the host plant. Adult females often lay their eggs on the plants that are the preferred food source for the caterpillars. Many adult hawkmoths are nocturnal or crepuscular, foraging for nectar from flowers. Orchids pollinated by hawkmoths often produce nectar in long tubular nectar spurs from which the hawkmoths drink. The moth's head or proboscis often brushes against the pollen-containing flower parts while foraging, resulting in pollen grains sticking to the moth when it leaves the flower. The moth may then transport the pollen to another flower where pollination can occur. Pollination, of course, must occur if the flower is to produce seeds for future generations. Understanding the pollination biology of prairie orchids is important for the development of management protocols for the species.

We have attempted to determine the number of different species of hawkmoths associated with prairies where the prairie orchids are found. We have employed three methods to document hawkmoth activity on prairie orchids: flower visitation, blacklight traps and mercury vapor lamps shining on white sheets. Occasionally, surveyors will sit by

Photo by David Ashley

A pollinator cone trap used in recent prairie surveys.

Photo by David Ashley

Plebian sphinx *(Paratrea plebeja)* hawkmoth with pollinia on head. Specimen was collected as it visited an orchid.

Photo by Steve Buback, Missouri Department of Conservation

Prairies are visited during the orchid flowering period. Data are collected on plant morphological features and location is determined (with accuracy to the nearest 5 decimeters) with Trimble GeoXH GPS equipment.

flowering orchids through all or a portion of the night, armed with insect nets for capturing moths as they visit the flowers. Headlamps with a red filter allow us to see the flowers and moths without disrupting the insect visitation. If we are quick (and coordinated) we can net the specimens for pinning and storage in entomology storage cabinets and ultimate examination for presence of orchid pollen. Blacklight traps are five gallon buckets outfitted with a circular blacklight bulb and a set of clear plastic panels that hold the bulb above a polished aluminum funnel which extends into the bucket. Many insects (including hawkmoths) are attracted to the wavelengths of light emitted, strike the clear plastic panels and fall into the bucket below. Specimens can be collected at the end of the sampling period or in the morning on a return trip to the prairie. We usually deploy multiple traps on each prairie and suspend them from a tripod constructed of electrical conduit. Each is powered by a rechargeable 12-volt tractor battery which is connected to a photocell. Multiple traps on multiple prairies are independently triggered to light as ambient light on the prairies decreases after sunset. We also occasionally utilize 250-watt mercury vapor lamps attached to tripods in front of vertically-suspended white bedsheets. Surveyors can manually collect insects attracted to the light reflected by the bedsheets. Power for the lights is provided by a small gasoline generator we bring to the prairies.

Using the diverse methodologies described above, we have documented fifteen species of Sphingids from the prairies that the orchid species inhabit. Some hawkmoth species have been collected by all three methods while some moth species have only been collected by a single technique. The mere presence of a hawkmoth species on a given prairie does not necessarily indicate that a given hawkmoth species is involved in orchid pollination. In fact, some of the species we have collected do not even feed as adults, ruling them out as

potential pollinators. Some species of hawkmoths have probosces that are much longer than the orchid's nectar spur; these may be considered "nectar thieves" because the length of the proboscis places its head so far away from the pollen packets that it is unlikely the pollen becomes attached while feeding on the nectar.

Collecting a specimen of a hawkmoth species as it visits the flower and viewing the orchid packets (pollinia) on the head or proboscis of the insect remains the most effective, direct evidence of pollination. Thus far, we have collected one plebian sphinx moth (*Paratraea plebeja*) which had pollinia attached to the head.

We continue our efforts to document pollination of *Platanthera* orchids on Missouri prairies. Unfortunately, the short flowering period of the prairie fringed orchids from late May to mid-June inhibits longer research periods. Pollination biology observations are generally restricted to this narrow window of time. After the bloom period, surveyors revisit plants later in the season to evaluate the production of viable seed pods on individual plants. Populations of prairie orchids have fluctuated from year to year in response to multiple abiotic factors. With the abundant moisture in spring 2015, we may be in for a banner year for pollination biology research of prairie fringed orchids in Missouri.

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Snowberry clearwing hawkmoth *(Hemaris diffinis)* feeding on milkweed at a northwest Missouri prairie.

Photo by David Ashley

Photo by Alexandra Harmon-Threatt

Pale purple coneflower *(Echinacea simulata)* in bloom. The glades in Meramec Mosaic Natural Area at Meramec State Park support suites of spring, summer and fall wildflowers full of nectar that attract many pollinators.

Native Bees of Meramec Mosaic Natural Area

by Dr. Alexandra Harmon-Threatt

Bee populations are declining. This is likely no surprise to readers of this newsletter considering the amount of publicity and concern dedicated to this issue in the mainstream media. However, the general public knows very little about these insects that are critical for pollination of many native and agricultural plant species.

When the word "bee" is mentioned, some immediately think of honey bees—the non-native, domesticated bees with queens and workers that most of us learn about in school. But in Missouri, hundreds of bee species exist, ranging dramatically in size, color, season of activity, and life history. Some of the largest native bees in Missouri are the size of an average thumb and the smallest can be the size of a winged ant. Most native bees do not have queens, hives, workers, or any of the traits common to honey bees. Rather, native bee solitary females create nests in holes in the ground, in twigs or in logs instead of hives. Native adult bees will only survive a few weeks, but their larvae will survive the winter in their nests in a suspended state before emerging the next year. These solitary bees are the ones that are largely responsible for a significant amount of pollination, but we know the least about them.

Unique landscape features in Missouri, diverse topography and quality natural ecosystems allow for exceptionally high bee diversity. For the past three years, I have worked with a team of research-

ers to investigate natural landscape patterns and responses of bees to a variety of factors including the spatial distribution of glade habitat and prairie management programs. Throughout this time, we have sampled multiple ecosystems across the state to answer a number of questions about bees. The prairies of southwest Missouri, for example, provided an appropriate landscape to study how bees respond to prairie management. Working on glades in the Ozarks, including sites in the Meramec Mosaic Natural Area at Meramec State Park, allowed a unique opportunity to examine response to fragmentation and isolation, two major threats to bee populations. Areas such as glades, characterized as bedrock communities and rocky outcrops dominated by perennial forbs and other prairie vegetation, are particularly interesting because their isolation from similar habitat types can create islands of high concentrations of long-lived perennial forbs and pollinating bees.

Of the Missouri state parks and conservation areas we visited during our study, the glades in the Meramec Mosaic Natural Area were the most isolated, with no easy access and requiring backcountry hiking long distances through thick brush. The location of the glades, mantled in the large contiguous wooded tract, increased the area's appeal for studying bee populations' natural responses to isolation. A significant acreage of the Meramec Mosaic Natural Area (which includes the glades we surveyed) has been managed with regularly occurring fire since 1992 with ten prescribed fires spanning 22 years. Walking through the shrubby woodland that often exists at the end of the fire return interval, it was difficult to imagine that the landscape harbors restored glades, but suddenly, bright light breaks through the canopy and glades appear, almost unrecognizable from the dense woodland. Once on the glades one immediately sees the bees zipping from plant to plant eagerly gathering pollen and nectar. After not seeing (or maybe simply not noticing) many insects while walking through the woodland, one may be immediately shocked by the sheer volume of grasshoppers, butterflies, bees and other insects on the glades. The abundance of insects other than bees can almost be distracting, but we were

Photos by Alexandra Harmon-Threatt

Small *Lasioglossum* species visiting Glade bluets (*Hedyotis nigricans*).

Sweat bee laps lightly at my hand in the field.

Soil cores taken in prairies can provide insight into soil characteristics

there for the bees. Sampling must be done swiftly and simultaneously to limit temporal turnover between sections of the glade. The sampling team must survey between 3 to 6 patches at a time using both hand netting and bee bowls, small colorful dishes filled with soapy water that attract bees. Few honey bees are found in these areas. These wild native places belong to the wild native bees.

During the 2013 glade bee research we discovered 61 species of bees across all 40 glades sampled on five conservation areas, state parks and designated natural areas. Of the areas sampled, we documented 33 species from Meramec State Park at Meramec Mosaic NA alone, with the highest number of species (9) found only within the natural area. Of the species unique to Meramec Mosaic Natural Area some are parasitic bees, including a sweat bee (*Sphecodes minor*), the red-footed cuckoo leaf-cutter (*Coelioxys rufitarsis*) and a stelis bee (*Stelis lateralis*). The presence of cleptoparasitic bees (which lay their eggs inside nests constructed by other bee species and as larvae feed on pollen provided by the host) is considered a sign of good health in bee communities because it suggests that the abundance of host populations is large enough to also support the less common non-cleptoparasite. This discovery of bee abundance at Meramec Mosaic NA is not particularly surprising as over 36 species of flowering plants were in bloom during our survey. Among the flowering plants, we documented Indian paintbrush (*Castilleja coccinea*), 3 species of tickseeds (genus *Corepsis*), 2 species of beardtongue (genus *Penstemon*), and prickly pear cactus (*Opuntia* sp.), some of which were not found flowering in any other glades. Purple prairie clover (*Dalea purpurea*) attracted the most bee species; purple prairie clover is often found on higher quality glades and often abundant where found. The native integrity of the glades in the natural area allowed for ample opportunities to witness bees in their native habitat.

Fire is an essential part of maintaining glade and prairie communities by removing dead plant material and often significantly increasing flowering, which benefits bee communities by maintaining the habitat and the resources they depend upon. Glades are often burned as part of a larger landscape-scale fire event, which benefits many suites of biota but may be critical for bees to allow movement between isolated patches. Fire also opens the canopy and woodland floor to provide for nesting and encourages understory flowering plants which bees need for additional food.

Dr. Alexandra Harmon-Threatt is interested in identifying natural patterns and responses of bees to a variety of characteristics including the spatial distribution of habitat of glades and habitat management of prairie systems.

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Tents erected at dusk help catch bees that are nesting in the soil. Stony Point Prairie, Lockwood, Missouri.

Photo by Alexandra Harmon-Threatt

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Ant Diversity in Fire-mediated Systems in the Ozarks

Questions that need Ants-wering

by Lizzie W. Wright

In recent years, I have perused much scientific literature regarding the effects of fire on arthropods. Many of these published articles analyze fire effects on arthropods rather superficially, at the level of order or, for a somewhat more in-depth perspective, at the family level. But arthropod species of the same genus may perform different functions, feed upon different organisms, and occupy different habitats, so these general studies are not as instructive as they may seem from the outset. In the best cases, arthropod species richness in fire-mediated systems is recorded, but cataloguing species richness does not paint much of a picture of how disturbance may shift community composition or the resulting community dynamics and function. To fully understand the effects of disturbance, specifically the impacts of fire on arthropods, it is important to recognize not only how species' reactions may differ, but also how ecological functions between species may change as a result of disturbance.

Natural resource managers and researchers in Missouri have embraced prescribed fire as a management tool for the sustainability of the state's rich natural heritage. The effects of fire on suites of biota have been widely studied throughout the state, although arthropods have been largely neglected in this regard, despite that they perform critical ecological roles in the ecosystem. Ants, in particular, are considered ecosystem engineers for their contribution to soil turnover, aeration, and chemical and structural modification as well as serving as important seed dispersers (Folgarait, 1998). While ants are a food source for other organisms, they live their lives as scavengers, hunters, thieves, farmers, omnivores, and slave-makers. Ants are abundant and therefore easy to sample; they are taxonomically diverse, but there are sufficient sources available for ant species identification. Ants

Photo by James C. Trager

Nestmates of the grassland/savanna ant *Formica biophilica* meet on a blooming tickseed *(Coreopsis palmata)* at Shaw Nature Reserve.

are sensitive to stress and disturbance; they are ecologically associated with a suite of other organisms and have a range of ecological functions, making them an ideal insect group to study in order to better understand landscape-scale disturbance and change (Noss, 1990, Underwood and Fisher 2006).

For two decades, Australian scientists have explored the effects of fire, flooding, pollution, grazing, agriculture, urbanization, silvicultural treatments, and resource mining on ant communities, and the ecological functions of those communities using a framework developed for ant functional groups (Andersen, 1995). The framework classifies ant genera and species based on ecological function such as behavioral dominance, climate specialization, and feeding behavior. The functional group scheme has been used repeatedly in Australia to measure ecosystem change and has been slowly adopted for studies in other countries. Comparisons of functional groups have been drawn between Australian and North American ant fauna and the use of the functional group model has been employed somewhat successfully in North American studies (Andersen, 1997).

What can ants tell us about natural community management using prescribed fire, about habitat

structure as a result of disturbance, and changes in overall community function post-disturbance in Missouri's fire-dependent ecosystems? Can we use ants as bioindicators of natural area health? These are questions that I am interested in answering, but no baseline information on ant communities or functional group composition exists in the Central Hardwoods region, or, more specifically, in Missouri. For my research I sought to answer a simpler question: How does prescribed fire affect ant communities and functional diversity in the Missouri Ozark Highlands? My research took me to areas in the Ozarks where managers were implementing prescribed fire, including Logan Creek and Clearwater Creek Conservation Areas in Reynolds County in the Current River Hills of the Ozarks. I also sampled at the University Forest Conservation Area in Butler County, located in the Black River Ozark Border Subsection.

Between June and July in 2011 and 2012, I collected ants and other arthropods using pitfall traps located in burned and unburned areas of each site. Specimens were taken back to the lab, sorted from other arthropods, and identified to species. Renowned ant specialist James Trager of the Missouri Botanical Garden's Shaw Nature Reserve confirmed identification of ant voucher specimens. All species were sorted into the appropriate functional group including Subordinate Camponotini (SC), Cold Climate Specialists, Tropical Climate Specialists (TCS), Cryptic Species (CS), Opportunists (OP), Generalized Myrmicinae (GM), and Specialized Predators (SP) (Table 1). No species belonging to the functional group Dominant Dolichoderine (DD) were found at my research sites. For application to Missouri of the Australian protocol, these functional groups are somewhat flawed as they are not all defined by the same ecological characteristics. To better understand the findings from this study, I further categorized the ants by assigning them to a nesting behavior group (arboreal, cavity/litter, soil, and wood nesting), and a size class (small, medium, large).

Clearwater and Logan Creek Conservation Areas' experimental units contained three 12 hectare blocks each with a burn unit and control treatment. Blocks 1 and 2 were burned in 2005 and block 3 in 2006. Ant sampling occurred 5 and 6 years after the last burn. 19,470 individuals across forty-four species were collected with 9,391 individuals in the burned areas and 10,039 in the unburned areas. Species richness did not differ dramatically between fire return intervals or control treatments. Statistical analyses revealed no significant effects of fire on functional groups, nesting groups, or size classes. Similarity index values that calculate species overlap of different assemblages showed there was very little change in ant community composition between control areas (unburned) and sites treated with fire. Only two species occurred uniquely in the burned sites, but at very low frequencies. Other research indicates that ant communities may be most sensitive to the habitat structure immediately after a disturbance event (Andersen, 1995, Farji-Brener et al. 2002, Mitrovich et al. 2010). While fire at the University Forest CA affected canopy openness (17.81% in burned areas compared to 12.87% in control areas based on Kinkead, 2013), it is likely that overall forest structure five and six years after the last prescribed fire event was homogeneous from the perspective of the ant communities present. Sampling for multiple years throughout the fire return interval may have shed more light

Table 1. Functional groups used in this study and their descriptions, based on Andersen (1995)

Functional Group	Description
Dominant Dolichoderine (DD)	Species that are aggressive and dominant usually favoring hot climates
Subordinate Camponotini (SC)	Large nocturnal species in the genus Camponotus that are competitively submissive to DD
Hot Climate Specialists (HCS)	Avoid DD and inhabit xeric, hot areas
Cold Climate Specialists (CCS)	Found in cooler climates free of DD
Tropical Climate Specialists (TCS)	Species found in warmer tropical climatic conditions with few DD
Cryptic Species (CS)	Small bodied ants that inhabit litter and soil with little interaction with other functional groups, especially epagaeic foragers
Opportunists (OP)	Rapid colonizers of recently disturbed areas with weak competitive ability and a wide ranging diet

Figure 1. Images of burn treatments at UFCA:

Photos by Rose-Marie Muzika

Control burn treatment

Annual burn treatment

Periodic burn treatment

on the mechanisms behind the similar ant community composition across treatments.

Managers at University Forest CA have implemented an experimental prescribed fire program since 1949 and 1951 when two 1.25 hectare blocks were established including two control treatments (unburned), two annually burned treatments, and two treatment areas burned every 5 years. Results from this study of highly mechanized fire events were drastically different from results collected at Clearwater and Logan Creek Conservation Areas. In an area a fraction of the size of Clearwater and Logan Creek CAs, 26,337 individual ants were found representing 54 species in the span of two years. Three of those species were Missouri state records, *Nylanderia trageri*, *Polyergus longicornis*, and *Strumigenys louisianae*. Abundance was highest in annual burns in 2011, though species richness was not found to be significantly higher based on treatment alone. Functional groups, nesting groups, and size groups illustrated some interesting patterns: cold climate specialists, subordinate Camponotini, wood nesters, and medium sized ants were found more often in control sites than in annual and periodically burned plots. Cryptic, cavity/litter nesters, medium, and small sized ants were positively associated with periodic burns. Cryptic, generalized Myrmicinae, ground nesting ants, and small ants monopolized annual burn sampling plots. Opportunists and large ants occurred across all treatment types. Analysis showed that overall community composition between treatments was quite different (Fig. 1): Control and annual burn plots represented the greatest departure between ant abundance. Periodic burn history plots contained ant communities that were similar to the control plots and similar to annual burn plots, indicating that periodically burned areas shared community characteristics with both of the other treatments (no fire and annual fire).

The temporal extent of the burn program (60+ years) at University Forest CA has shaped forest structure. Control areas are closed canopy forests dominated by oak/hickory with a distinct midstory containing mixed mesophytic species and an understory of leaf litter, the occasional seedling, and vines of the genus *Smilax*. While units located in the areas of periodic burns have more canopy openness, these areas lack a midstory and, depending on time since the last burn, may possess a distinct shrub layer of oak sprouts and other shrubs and forbs in the understory. Annual burn plots possess a more open canopy with fewer larger diameter oaks and hickories and a dense, though homogenous, forb layer with very little leaf litter. Although these areas with an annual burn treatment do not represent a realistic histor-

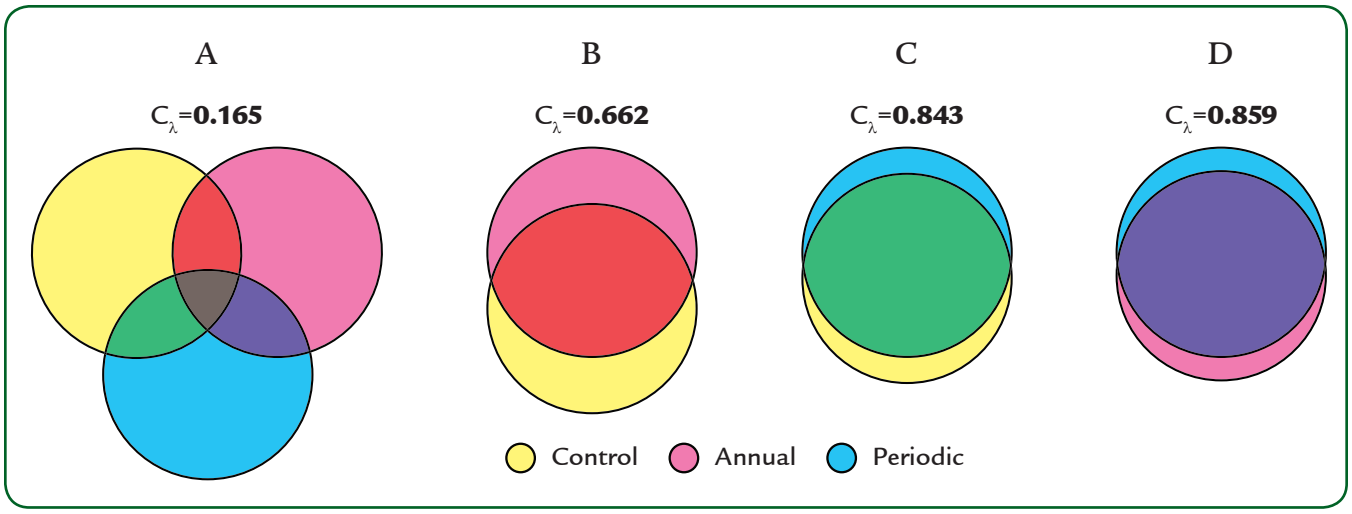

Figure 2. A) Abundance-based Morisita similarity indices (C_λ) between all treatments combined. Pairwise incidence-based Morisita similarity indices between B) control and annual, C) control and periodic, and D) annual and periodic burns. The more the circles overlap the more similar the assemblages.

ical fire regime, they may vaguely represent different successional stages of forests exposed to fire or, conversely, devoid of it. The three treatment areas present a heterogeneous mosaic of habitat structure relating to ants with distinct ant communities and high diversity within 2.5 hectares.

When compared with Clearwater and Logan Creek Conservation Areas (study area=36 hectares), ant community composition, functional group composition, nesting groups, and size class groups are quite similar to those of the control plots at University Forest CA. When comparing incidence-based similarity indices that calculate the species overlap of separate assemblages, control plots at University Forest CA were 79% similar to controls and 85% similar to burn plots at Clearwater and Logan Creek CAs. It is also important to note that 9,554 out of 19,470 individuals at Clearwater and Logan Creek CAs were of one species, *Camponotus chromaioides*, also a dominant species in control plots at University Forest CA. These results indicate that, from an ant's perspective, more frequent burning may need to occur in order to increase overall taxonomic and functional diversity of ant communities at the landscape-scale. The diversity in ant community composition and function at a small, spatial scale at University Forest CA may be the result of the variation in habitat structure resulting from multiple prescribed burns (Andersen, 1995; Farji-Brener et al. 2002; Mitrovich et al. 2010).

From these preliminary data, I recommend further inquiry into the effects of habitat structure and disturbance impacts on ant community composition and function in the Missouri Ozarks. These organisms and their roles in the ecosystem should be considered more seriously in regard to short and long-term ecosystem change. Ants represent an important, but historically neglected, component of biological diversity.

Lizzie W. Wright worked with Dr. Rose-Marie Musika at the University of Missouri and graduated with a M.S. in 2013. The article is based on findings from her thesis research.

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References:

Andersen, A. N. 1995. A classification of Australian ant communities, based on functional group which parallel plant life-forms in relation to stress and disturbance. *Journal of Biogeography* **22**:15-29.

Andersen, A. N. 1997. Functional groups and patterns of organization in North American ant communities: a comparison with Australia. *Journal of Biogeography* **24**:433-460.

Farji-Brener, A. G., J. C. Corley, and J. Bettinelli. 2002. The effects of fire on ant communities in north-western Patagonia: the importance of habitat structure and regional context. *Diversity and Distributions* **8**:235-243.

Folgarait, P. J. 1998. Ant diversity and its relationship to ecosystem functioning: a review. *Biodiversity and Conservation* **7**:1221-1244.

Kinkead, C. 2013. Thinning and burning in oak woodlands. Master's thesis. University of Missouri, Columbia, MO.

Mitrovich, M. J., T. Matsuda, K. H. Pease, and R. N. Fisher. 2010. Ants as a measure of effectiveness of habitat conservation planning in southern California. *Conservation Biology* **24**:1239-1248.

Noss, R. F. 1990. Indicators for monitoring biodiversity: a hierarchical approach. *Conservation Biology* **4**:355-364.

Underwood, E. C. and B. L. Fisher. 2006. The role of ants in conservation monitoring: If, when, and how. *Biological Conservation* **132**:166-182.

Photo by Brett Budach

Regal Fritillary *(Speyeria idalia)* on pale purple coneflower (*Echinacea pallida*) at The Nature Conservancy's Goodnight-Henry Prairie.

Butterfly species as Habitat Indicators

by Brett Budach

The tie is strong between Lepidoptera (moths and butterflies) and the vegetation that their larvae consume. Many species will not feed on plants outside a particular genus, while a select few may rely on a single species. This makes Lepidopteran species composition an interesting reflection of the vegetative community in which those species occur. While not always a reliable measure, many species of Lepidoptera disappear as their habitat is degraded or destroyed. With some exceptions, the greatest threat to native Lepidoptera in the state of Missouri is the degradation and destruction of suitable habitat, that is, habitat composed of native plants that provide nectar for adults and foliage for specialist larvae. Secondarily, the limited knowledge about life histories also restricts how (or if) management of habitat can (or should) be altered to cater to certain species and how we understand the function of the ecosystems in which they occur.

The state listed (S3) Regal Fritillary (*Speyeria idalia*) serves as a great example. A notable prairie endemic, the Regal Fritillary is a large and showy butterfly with a unique life history. The adults emerge from pupae in early summer, with males first appearing in late May or early June and females one to two weeks later. The males set up "territories" in which they scout for females and ward off other males. The females mate with the males soon after emergence. For the remainder of the growing season, the males will slowly fade while the females persist and lay eggs. The constant activity of these adult butterflies requires a supply of energy in the form of sugary nectar, usually provided by a consistent bloom of prairie plants. The female Regal Fritillary will lay eggs randomly across a prairie, eventually depositing hundreds in the thatch. This is interesting because Regal Fritillaries are dependent on a select few species of violets (*Viola spp.*) as host plants, notably V. *pedatifida* with credible records of V. *pedata* and V. *sagittata* as well. One would expect

a butterfly with such choosy offspring to be equally choosy about where she placed her eggs, but this is apparently not the case. Such behavior is actually typical of the genus *Speyeria* and is observed in the more common Great Spangled Fritillary (*Speyeria cybele*) and less common Diana Fritillary (*Speyeria diana*). Tiny larvae will emerge out of those randomly placed eggs in the autumn but will spend the rest of the growing season and all of winter in a dormant stage. It isn't until the warmth of the following spring when the native violets begin to emerge that the larvae will begin looking for food. They will feed on the violets, grow to maturity and pupate, and when the adults emerge from those pupae, the cycle will continue.

Not surprisingly, butterflies and moths that are strongly tied to native vegetation are negatively impacted by the loss or conversion of that vegetation. If there are no host plants for the larvae to feed on, they will not grow to maturity and emerge as adults. If there is no nectar for the adults, they may not live long enough to mate and lay eggs. In the case of the Regal Fritillary, native violets are essential for the growth of the larvae, and a constant supply of nectar throughout the growing season is essential for the survival of adults seeking mates and laying eggs. In essence, without high quality and intact networks of tallgrass prairie (home to many native violets and a vast array of flowering plants), the Regal Fritillary ceases to exist. This claim is supported by the rapid disappearance of the species from much of its range as the tallgrass prairie biome was plowed under and remnants (often hay-meadows) were converted to cool-season pastures. While most butterflies and moths are more general in their appetites and habitat requirements, the pattern of decline in the Regal Fritillary is mirrored by many other taxa.

Certain species of Lepidoptera such as the Regal Fritillary may seem to be perfect indicators of quality habitat, but a single species should never stand alone as an "indicator." By late summer, many female Regal Fritillaries have dispersed over great distances in search of healthy nectar sources and can be found in a wide variety of habitats. In the scorching heat of late August in 2012, there

Photo by Brett Budach

A Baltimore Checkerspot *(Euphydryas phaeton ozarkae)* nectaring on Lance-leaf Coreopsis *(Coreopsis lanceolata)* at St. Francois Mountains Natural Area

were multiple sightings of Regal Fritillaries nectaring on cultivated garden plants in the suburbs of Kansas City. Those individuals likely dispersed off of parched prairies in a desperate search for nectar. It is subtle nuances like this that should make us think twice about how "indicator" species of Lepidoptera can influence our understanding and management of quality habitat. It is recommended to examine the entire suite of species of Lepidoptera at a site, allowing for a far more accurate reflection of vegetation and diversity. Interestingly, some patterns of response to management emerge across many taxa. For example, Lepidoptera that overwinter in the understory or thatch are often eliminated by fire and must recolonize burned sites from surrounding habitat or refugia set aside within the site itself. Timing of fire and other natural disturbance factors at a site can adversely affect Lepidoptera, which makes an understanding of those species' life histories essential for proper management to protect all facets of biodiversity.

The Missouri Natural Areas System defines

Photo by Brett Budach

An Olive Hairstreak *(Callophrys gryneus)* nectaring on Slender Mountain Mint *(Pycnanthemum tenuifolium)* at Paintbrush Prairie NA.

natural areas as "biological communities...that preserve and are managed to perpetuate the natural character, diversity, and ecological processes of Missouri's native landscapes." Conserving viable natural ecosystems requires protecting their ecological integrity. But it is difficult to protect and manage high quality ecosystems if practitioners are unaware of the various facets of functioning systems and the species that inhabit them. In the case of Lepidoptera, known to be in peril from external threats, our knowledge of taxonomy and specific life histories is severely lacking. For instance, the Ozark Highlands are home to an endemic subspecies of Baltimore Checkerspot (*Euphydryas phaeton ozarkae*) that feeds primarily on False Foxglove (*Aureolaria spp.*), typically found on glades and open woodlands. Another subspecies, found in the eastern range of the Baltimore Checkerspot, *Euphydryas phaeton phaeton*, feeds on Turtlehead (*Chelone glabra*) in open mesic habitats but has recently adapted to feeding on non-native Plantains (*Plantago spp.*) in more disturbed locations. There are noticeable morphological differences between the adults of the two subspecies. *Euphydryas phaeton ozarkae* may be better served if treated as a recent geographically-separated sister species that is "young" evolutionarily; this subspecies has recently adapted to the unique habitats and vegetation of the region, but remains a subspecies due to uncertainty in molecular taxonomy. Such discrepancies often limit our knowledge of species found in our natural areas which limits our ability to protect and manage biota across the gradient of an ecosystem. This is a troubling reality when there are hundreds of butterfly and moth species in Missouri, not to mention thousands of other suites of biota that depend on our dwindling natural resources. Education, research, and monitoring of the delicate ecological facets that work together to create healthy, vibrant systems should remain a primary goal of land management agencies.

Brett Budach, a member of the Idalia Society of Mid-American Lepidopterists, studies at Kansas State University and is currently working with the Institute of Botanical Training.

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Photo by Allison J. Vaughn

The top of Devil's Wall at Taum Sauk Mountain State Park provides striking vistas of the St. Francois Mountains NA in November.

St. Francois Mountains Natural Area Highlights

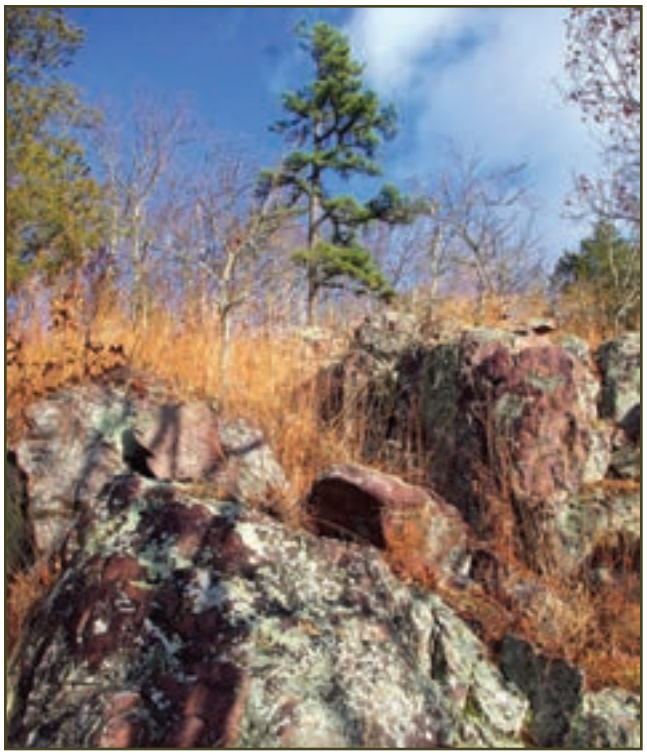
by Ron Colatskie

When I ask colleagues for help with various projects in the St. Francois Mountains Natural Area (SFMNA), I imagine apprehensive images flash through their mind: the prospect of taking a tumble as their ankle wedges between rhyolite boulders, enduring the searing July heat on a south-facing igneous glade, or encountering a timber rattlesnake worthy of an entry in Paul McKenzie's 'Boone and Crockett' record book. While a minority of anxious colleagues see an opportunity to bathe in the air conditioning, the majority always look forward to tromping through the unique assemblage of natural communities that exist in this ancient volcanic landscape.

The impetus to highlight the natural quality of the St. Francois Mountains region, nestled in Iron, Madison, St. Francois, and Reynolds counties, dates back to 1990 when the legislature supported the purchase of Taum Sauk Mountain as a state park. Wayne Gross, then Director of the Missouri state park system, accepted the proposal to acquire the 28 separate privately owned properties from willing sellers by Don Schulteheinrich. Don was a land acquisition specialist who understood the true meaning of landscapes qualifying as premiere state parks. In subsequent years, Paul Nelson, then Director of the Natural History Program for the state park system proposed to the Missouri Department of Conservation that the majority of Taum Sauk Mountain and adjoining Ketcherside Conservation Area be designated as a Missouri natural area.

The SFMNA is a microcosm of features that comprise the St. Francois Mountains. Missouri's deepest valley, highest mountain, highest waterfall, most exceptional Ozark igneous stream, a plethora of geologic phenomena, seven igneous knob mountains, all mantled in high quality woodlands, glades, forests, acid fens, cliffs and talus slopes exist over igneous volcanic rock. These proved to be the best representation of a large landscape typical of the St. Francois Mountains

Photo by Ron Colatskie



Upland flatwoods quickly give way to steep slopes intermingled with igneous boulders on Taum Sauk Mountain. Prairie grasses and shortleaf pine take advantage of the harsh microsite conditions.

Photo by Ron Colatskie

Hoary Edge Skipper *(Achalarus lyciades)* feeding on a Mead's Milkweed *(Asclepias meadii)* in the St. Francois Mountains NA.

region. As such, the Missouri Natural Areas Committee saw fit to nominate this globally significant 7,028 acre landscape in October of 1996.

Colleagues who have worked in this natural area always seem eager to share their experiences from their time in this ecological playground. One ecologist cites the igneous glade-pocked landscape for kindling his interest in nature as a 13 year old boy scout, another ecologist spoke of his excitement when he found a particular rare plant that had evaded detection in the region for nearly a century, a botanist marveled at the true gestalt of a high quality igneous glade and burn bosses routinely share war stories about implementing prescribed fires in the steep and rugged landscape.

Geologists can read the story of the development of the Ozark landscape, written in stone, in the SFMNA. At the geologic heart of the Ozarks, the SFMNA owes its existence to an ancient, violent, volcanic landscape. In a literal 'Precambrian explosion' of a different sort, the rocks in the SFMNA formed 1.5 billion years ago through volcanic eruptions with the resulting high-energy, high speed ash-flow tufts that solidified into the igneous stone we find today. The echoes of the Ozark's Highlands' volcanic past have produced several outstanding geologic features that persist in the natural area with names as rugged as the features exist: Mina Sauk Falls, Devil's Tollgate, and Devil's Wall.

For intrepid botanists, the SFMNA harbors a fascinating mosaic of natural communities, containing a flora with attributes that even today indicate an ancient dynamic process, with a heterogeneous ebb and flow of glade, woodland and forest flora. Some have theorized that the greater St. Francois Mountains Region was an extensive network of igneous savanna communities as a result of the maximum warming and drying of the Xerothermic Interval, the echoes of which may have been maintained further in time by aboriginal and lightning fires.

The gems lining the crown of the SFMNA may be the igneous glades, which pepper the landscape. These glades serve as islands for prairie flora, dependent on an intact shallow soil profile and with an acidic, igneous flavor. Representative flora include white prairie clover *(Dalea candida)*,

prairie parsley *(Polytaenia nuttallii)*, and upland white aster *(Symphyotrichum ptarmacoides)* all nested in a matrix of prairie grasses. The igneous glades are fringed and intermingled with woody vegetation, which affords a savanna-like appearance as prairie grasses proliferate beneath scattered, open canopies of gnarled shortleaf pine, post oak and blackjack oak.

The majority of the SFMNA is comprised of igneous woodland and forest communities with a broad spectrum of expression. Floristic sampling indicates the dry igneous woodlands harbor the most species-rich communities of the SFMNA as glade flora intermingle with a variety of woodland flora, while below, in mesic environs on toe slopes of the rugged hills, acid seep communities host a rich assortment of mesophytic flora. On broad summits of some igneous domes, upland flatwoods communities harbor flora tolerant of the extreme environments thanks to a water-restricting fragipan. Throughout 4.25 miles of the natural area, Taum Sauk Creek, a designated Outstanding State Resource Water, flows through a gauntlet of igneous boulders, the entire watershed protected by Taum Sauk Mountain State Park. The scenic, clear waters of the creek pool in stretches managed by beavers and are often fringed with thickets of alder and witch hazel.

Although many of the natural communities in the SFMNA are of high quality, ecological restoration activities are imperative in order to restore and maintain a functioning natural system: Prescribed fire is integral for the fire-mediated communities, careful ecological thinnings restore open woodland structure, while biological surveys are key to documenting the trajectory of natural community health.

Due to the remoteness and rugged terrain inherent throughout the area, ecosystem management activities are often challenging to implement. In 2009, a severe windstorm leveled thousands of trees throughout the region, impacting the prescribed fire program efforts that had occurred frequently throughout the 1990's. However, with aid of crews from AmeriCorps-St. Louis, a substantial grant from the Missouri Bird Conservation Initiative, and collaboration between agencies, fireline installation and prescribed fire

Photo by Ron Colatskie

Total destruction: rooting by feral hogs destroys the thin igneous glade soils and the sensitive flora that depend on them. These damaged sites may not support conservative flora for decades or even centuries. The strong feral hogs easily overturn igneous stones, altering habitat for fauna such as collared lizards and other glade species.

occurred in the natural area across 1,800 acres since 2013, with one large burn unit at Taum Sauk Mountain State Park seeing fire for the first time in over 15 years.

Threatening the natural character of the SFMNA and arguably the greater portion of the Ozarks, perhaps surpassing all other threats by leaps and bounds, is the detonation of the 'hog bomb', the rapid growth of feral hog populations induced by illegal hog release since the 1990's. No invasive species is better suited for wholesale destruction of the fragile natural communities in the natural area. Perhaps at ground zero of the 'hog bomb' detonation, the SFMNA has much to lose; once feral hogs root through the thin glade soils, conservative glade flora are replaced by generalist species such as common rushfoil *(Croton wildenowii)* and southern ragweed *(Ambrosia bidentata)*. Hogs wallow in ephemeral flatwoods ponds and acid seeps and root up woodland and forest communities, leaving the ground layer to appear as if hundreds of autonomous rototillers range

free, as leaf litter and soil are displaced in their search for anything edible, plant and animal alike.

Without the effort to mitigate the feral hog numbers, all other ecological restoration activities may be negated as rooting activity could permanently displace the flora and fauna vital for repatriating the biodiversity of restored natural communities. Several state and federal agencies are working together to address issue, employing a cocktail of methods including trapping, aerial gunning and use of snares to eradicate feral hogs from the natural area. In August 2015, gut contents from trapped hogs will be investigated in a project funded by the Missouri Department of Natural Resources. With continued support for such efforts, the biodiversity of the rich igneous landscape will be ensured.

Each season in the SFMNA provides a unique treat, whether it is meandering through ice-glazed boulders in heart of winter, observing a showy display blazing star in mid-summer, or kicking up a woodcock in early spring. One of the best transects to drink in this igneous world is along a portion of Ozark Trail, over 11 miles of which meander through the natural area from Taum Sauk Mountain State Park, west through Ketcherside Mountain Conservation Area, and finally towards Johnson's Shut-Ins State Park. For those with more limited schedules, a hike along the Mina Sauk Falls Trail offers three miles through woodlands, glades, and associated scenic vistas. A visit will reveal why the Missouri Natural Areas Committee designated this landscape as one of the best representations of globally significant igneous natural communities in the state.

For access information visit the Missouri Department of Conservation website.

Ron Colatskie is the Eastern Parks District Natural Resource Steward with the Missouri Department of Natural Resources. Ron is interested in the dynamics of plant community ecology and the evolving science of natural community restoration.

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Photo by Ron Colatskie

A fork-tailed bush katydid nymph (above) adorned with a variety of colors, perhaps allowing it to readily blend in with the same suite of colors of mid-summer glade flora as found on this glade in the SFM-NA. A lichen grasshopper (below) shows off its camouflage, blending in with a lichen-encrusted rhyolite boulder.

Photo by Ron Colatskie

Photo by Anna Weyers, U.S. Fish and Wildlife Service

Cypress and tupelo gum-dominated swamps cover approximately 980 acres in the newly designated Mingo NA.

Missouri's first National Wildlife Refuge Natural Area designated at Mingo NWR

by Ben Mense

In May 2015 the Missouri Natural Areas Committee (MoNAC) unanimously approved the nomination for the 8,452-acre Mingo Natural Area. MoNAC will seek final approval by the directors of the Department of Conservation, the Department of Natural Resources and the Regional Director of the Midwest Region of the U.S. Fish and Wildlife Service. If approved, Mingo NWR will be the only National Wildlife Refuge in Missouri with a Missouri Natural Area designation and the largest natural area in the state of Missouri.

The Mingo Natural Area lies within the Mingo National Wildlife Refuge, which supports the largest remnant of bottomland forest and other lowland natural communities left in the Southeast Missouri Lowlands. Historically, this region of Missouri harbored over 2 million acres of bottomland forest and related communities. At the core of the natural area is the Mingo River, one of the least modified lowland streams remaining in Missouri's Bootheel region.

Forty-two species of conservation concern including mammals, birds, amphibians, reptiles, fish, insects, and plants utilize the Mingo Natural Area. Species of note include the Indiana bat (*Myotis sodalis*), Least bittern (*Ixobrychus exilis*), Western mudsnake (*Farancia abacura reinwardtii*), Taillight shiner (*Notropis maculatus*), and Featherfoil (*Hottonia inflata*). The Mingo Natural Area supports three miles of the Mingo River and 8,216 acres of bottomland natural communities that are home to hundreds of native plant species, as well as many breeding and migratory bird species, native fish, and herpetofauna. 236 acres of upland forest habitat surround the Mingo Natural Area, host to many upland species and an important hibernacula for the Western cottonmouth (*Agkistrodon piscivorus leucostoma*).

Management of the natural area includes the management of water levels to simulate natural flooding cycles, restoration of sheet-flow water surges through the refuge, and monitoring and treating invasive and exotic species while providing habitat for a variety of wildlife species. The area is easily accessible to the public via the Ozark Highlands Auto Tour Route, which includes numerous overlooks that provide excellent viewing opportunities. Public uses such as hunting, fishing, hiking, paddling, and wildlife photography are all popular activities throughout the refuge. The natural area designation will insure that all of these activities and protection of this rare landscape type in Missouri will continue in perpetuity.

Ben Mense is the Refuge Manager at Mingo National Wildlife Refuge
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Western mudsnakes (*Farancia abacura reinwardtii*) are among the 42 species of conservation concern that have been documented from Mingo NA.

Photo by Dan Scheps, Missouri Department of Conservation

2015–2016 Calendar Of Events

August 20–21, 2015

Missouri Bird Conservation Initiative Conference

Columbia, MO

This year's theme, "To Kill a Mockingbird," will focus on threats to birds, with wide-ranging speakers and a poster session to highlight conservation efforts by previous recipients of the annual MoBCI grants program. Online registration now available.

Visit <www.mobci.net> for more details and registration.

August 29, 2015

Hummingbird Banding

Cape Girardeau Conservation Nature Center
Cape Girardeau, MO

Hummingbirds are gathering around feeders, getting ready for their long journey south. Stop by and watch as hummingbird banders attempt to catch these little gems, gather data, and fit them with an ID band before releasing them. No registration required. Youth and adult groups welcome.

September 11, 2015 • 4–7:30 p.m.

Shaw Wildflower Market

Whitmire Wildflower Garden
Gray Summit, MO

The Shaw Wildflower Market is geared for new and experienced gardeners and people looking for locally made products. Native Plant Experts will be on hand to answer questions, identify plants and give guidance to gardeners wishing to expand their plant palette with native plants.

Directions and further details:
<www.missouribotanicalgarden.org>

October 2, 2015

Fire Management Field Tour

Chilton Creek Research & Demonstration Area
Van Buren, MO

The Chilton Creek Research and Demonstration Area is the largest Nature Conservancy owned property in Missouri at more than 5,500 acres.

For more information visit:
<www.oakfirescience.com/workshops>

October 10, 2015

Missouri Prairie Foundation Annual Meeting and Evening on the Prairie

Preceded by Prairie Day activities organized by the Hi Lonesome Chapter of Missouri Master Naturalists.

Visit <www.moprairie.org> for more details.

November 3–5, 2015

National Natural Areas Conference

Little Rock, AR

"Conservation through Collaboration." This year's conference will explore many of the top issues that currently face conservation professionals, focusing on emerging changes in the conservation paradigm and the need for communication and constituency building in today's ever-changing political and social climate. Other topics at this year's conference will include cutting-edge techniques for managing open pine ecosystems, prescribed fire, and river restoration.

Registration and details:
<www.naturalareas.org/conference>

January 24–27, 2016

76th Midwest Fish and Wildlife Conference

Grand Rapids, MI

The annual conference attracts over 800 biologists and students from state, federal and tribal natural resource agencies across the 13 Midwestern states. Highlights include: over 400 technical talks, poster displays, plenary sessions, networking opportunities and social events.

More information: <www.midwestfw.org>

February 3–5, 2016

Missouri Natural Resources Conference

Osage Beach, MO

"Balancing Economics, Conservation and Adaptive Management in a Changing World"

More information: <www.mnrc.org>